

NON-PUBLIC?: N
ACCESSION #: 9109090267
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Catawba Nuclear Station, Unit 2 PAGE: 1 OF 05

DOCKET NUMBER: 05000414

TITLE: Unit 2 Reactor Trip Due To An Equipment Failure Which Caused
Reactor Coolant Pump 2B To Trip
EVENT DATE: 05/29/91 LER #: 91-008-01 REPORT DATE: 08/27/91

OTHER FACILITIES INVOLVED: N/A DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR
SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: C. L. Hartzell, Compliance Manager TELEPHONE: (803) 831-3665

COMPONENT FAILURE DESCRIPTION:
CAUSE: F SYSTEM: AB COMPONENT: BRK MANUFACTURER: G182
REPORTABLE NPRDS: Y

SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT:

On May, 29, 1991, at 0049 hours, Unit 2 was in Mode 1, Power operation, when a Reactor trip, occurred due to low flow on Loop 'B' of the Reactor Coolant (NC) System. The 6900 Volt switchgear feeder breaker, 2TB-3, for NC Pump 2B had tripped due to a spurious activation of a ground fault relay. The unit trip response was normal. Low - Low Steam Generator Level initiated the Auxiliary Feedwater (CA) System. The NC system was stabilized when control room operators reset the CA Auto Start and steam generator levels returned to normal. Power Delivery personnel determined that a Silicon Controlled Rectifier (SCR) within the relay had become electrically degraded, resulting in the spurious initiation of 2TB-3. The SCR was replaced and the relay was returned to service. This incident has been attributed to an Equipment Malfunction due to the degraded SCR. The remaining NC Pump ground fault relay SCRs were tested with no other failures detected. Corrective actions include testing a

sample group of switchgear relays and to add SCR tests to the existing switchgear protective relay preventive maintenance activities.

END OF ABSTRACT

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BACKGROUND

The Unit 2 6900V Normal Auxiliary Power EHS:EA! (EPB) System distributes power to the four Reactor Coolant EHS:AB! System (NC) Pumps EHS:P! (RCP) Switchgear EHS:SWGR! as well as providing power to the condensate/conventional water pump switchgear. The 6900V RCP switchgear associated with each pump is connected to the respective 6900V feeder breaker EHS:BRK! (2TA-3, 2TB-3, 2TC-3, and 2TD-3). Each RCP switchgear breaker is protected by an instantaneous ground fault relay EHS:RLY! (50G) and an instantaneous/ time-delay overcurrent relay (50/51). Actuation of either relay will trip the RCP Switchgear breaker. RCP Switchgear may also be tripped by inputs from the Solid-State Protection System EHS:JC!, by manual TRIP pushbuttons, or by other means such as interlocks dependent on NC pump lube oil pressure sensors EHS:XT!, under-voltage relays, etc... .

The RCP switchgear breakers are ground fault protected by an ITE/Gould relay device, Type GR-5 (also known as a ground shield). A sensor mounted around the three phase conductors EHS:CON! that supply power to the NC Pump motor EHS:MO!, detects a magnetic field generated by the current flow. The magnetic field detected by the sensor is at a minimum when the circuit is operating properly. If an improper ground condition develops, the current developed by the magnetic field will increase to a point where the Silicon Controlled Rectifier (SCR) within the relay will energize the trip coil, eventually causing the associated breaker to open.

SCRs are, the most popular of the semiconductor switches within the Thyristor family (devices which use regenerative feedback to perform a bistable action). The SCR is officially classified as a reverse blocking triode thyristor due to its unidirectional current flow characteristics. Current flow through the SCR ("anode to cathode") is initiated by applying the proper control voltage to the SCR "gate".

The Catawba Nuclear Station Unit 2 NC System consists of four identical heat transfer loops with one exception. A pressurizer is employed on the Loop 'B' Hot Leg to minimize NC System pressure variations. Each NC loop has three flow transmitters which supply inputs to the Reactor Protection System. A reactor trip occurs when 2 out of the 3 transmitter channels

detect a low flow condition in one NC loop.

EVENT DESCRIPTION

On May 29, 1991, at 0049 hours, Unit 2 was operating in Mode 1, Power Operations, when a ground fault relay initiated spuriously and caused 6900V Supply Breaker 2TB-3 to open. This deenergized NC Pump Motor 2B. The unit tripped on, the subsequent low reactor coolant flow condition in Loop B, which was detected by flow transmitters (2NCFT5030, 5040, and 5050).

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Unit response to the trip was normal. However, NC temperature cooled to 538 deg F due to the fact that both units auxiliary steam loads were being supplied from Unit 2. All four steam generator EIIS:HX! Low-Low Level setpoints were reached resulting in Motor Driven and Turbine EIIS:TRB! Driven Auxiliary Feedwater EIIS:BA! CA Pump starts. The Control Room Operators reset the CA Auto Start and steam generator level returned to normal.

Station Power Delivery (PD) personnel inspected the NC Pump-feeder/supply breakers, cables, pump, and motor for NC Pump 2B. The failed relay was tested and initially appeared to be normal. Further testing revealed that the electrical characteristics of the SCR had changed, which caused the initiating threshold to shift. The SCR was replaced and the relay was returned to service. PD also tested the remaining NC Pump ground fault relays SCRs without discovering another failure.

On May 30, at 0010 hours, Unit 2 reentered Mode 1, Power Operation.

CONCLUSION

This incident is attributed to an Equipment Failure in that an SCR within the ground detecting relay spuriously actuated and caused the 6900V supply breaker to open, deenergizing NC Pump Motor 2B. The SCR had become electrically degraded, causing the triggering threshold to become more sensitive. The most likely cause for the spurious initiation is that electrical noise or a spike occurred, which was detected by the relay as a ground fault condition.

Immediate action was to replace the degraded SCR in the 2TB3 50G relay, along with testing of the remaining Unit 2 NC Pump ground fault relay SCRs. The Unit 1 NC Pump and Hotwell Pump ground fault relays were tested for defective or marginal SCRs. Of these relays, one SCR was found to be marginally degraded. This SCR was considered to be bad

because it had a leakage current of 170 micro-amps. This is above the 100 microamps at approximately 400V leakage allowed, but not nearly as high as the leakage current found in SCR that tripped Unit 2.

SCRs are used in approximately 600 power circuits (safety and non-safety related) throughout Catawba Nuclear Station. Few failures have been discovered with no distinguishable pattern. A review of the Operating Experience Program did not reveal any Reactor trips or events related to failures of these relays or SCR's. Therefore, this event is not considered to be a recurring problem. All Unit 1 NC Pump breaker ground fault relay SCRs were tested prior to unit restart. McGuire and Oconee Nuclear Stations were notified about this failure. Planned corrective actions include additional tests of protective relay SCRs during the performance of routine preventive maintenance activities.

The long term solution to this problem is to periodically test the SCRs used in switchgear protective relaying. This will be performed during the currently active Preventive Maintenance (PM) testing of the associated relay. These additional actions will not significantly impact the relay PM and will identify

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marginal SCRs. The SCRs can then be removed before system transients (electrical noise/spikes) can cause them to react. The failed SCRs found during the switchgear relay tests and other relay maintenance will be trended and monitored to identify a pattern if a significant quantity of failures. All switchgear protective relay SCRs should be tested by the end of the next three refueling outages on each unit as one-third of the relays on each unit are tested during its respective outage. Further action will be taken as failure rates of the SCRs dictate.

Industry-wide, the vendor has indicated a failure rate of less than 0.1% over the past 10 years. At Catawba, 11 SCR failures have been identified, previous to the May 29, 1991 incident. Previous relay test methods led to detection of failed (i.e. open) SCRs. The method now being used to test SCRs can detect degradation less severe than total SCR failure, which could result in tripping a relay. This testing should enable detection of degraded SCRs prior to failure.

The SCR failure is reportable to the Nuclear Reliability Database System (NPRDS). Defective SCRs have been sent to Motorola for testing to determine cause of failure. this report will be, revised, if needed, based on the outcome of this failure analysis. Part 21 reportability will be re-evaluated, if needed.

CORRECTIVE ACTIONS

SUBSEQUENT

- 1) Operations personnel responded to the trip and recovered Unit 2 to normal Mode 3, Hot Standby, condition.
- 2) PD personnel investigated the power circuit and replaced the failed SCR.
- 3) PD personnel tested the remaining Unit 2 NC Pump ground fault relays.
- 4) PD personnel tested Unit 1 NC Pump ground fault relays prior to unit restart following its refueling outage.

PLANNED

- 1) PD will test a sample group (30-40), of switchgear protective relays.
- 2) PD will add SCR tests to the existing switchgear relay preventive maintenance activities.

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SAFETY ANALYSIS

At the time of this incident, Unit 2 was operating at 100% power. The trip occurred due to low NC flow in loop 'B' which was caused by the spurious opening of NC Pump 2B 6900V Supply Breaker. Following the reactor trip, reactor power immediately decreased to zero. No primary or secondary Power Operated Relief Valves or Code Safety Valves were lifted during the transient. The reactor cooldown was terminated with a NC temperature of 538 deg F at 1950 PSIG and a secondary (main steam) pressure of 990 PSIG. The normal NC temperature is 557 deg F. The deviance from the normal conditions was due to the auxiliary steam loads of Unit 1, which was in a refueling outage. Primary cooldown rates did not exceed 100 deg F/hour and adequate core heat removal was available through use of the steam generators and the CA System water supplies.

The health and safety of the public were unaffected by this incident.

ATTACHMENT 1 TO 9109090267 PAGE 1 OF 1

Duke Power Company (803)831-3000

Catawba Nuclear Station
P.O. Box 256
Clover, SC 29710

DUKEPOWER

August 29, 1991

Document Control Desk
U. S. Nuclear Regulatory Commission

Washington, D. C. 20555

Subject: Catawba Nuclear Station
Docket No. 50-414
LER 414/91-08, Rev. 1

Gentlemen:

Attached is Licensee Event Report 414/91-08, Revision 1, concerning UNIT
2 REACTOR TRIP DUE TO AN EQUIPMENT FAILURE WHICH CAUSED
REACTOR COOLANT
PUMP 2B TO TRIP.

This event was considered to be of no significance with respect to the
health and safety of the public.

Very truly yours,

J. W. Hampton
Station Manager

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